09/025122
405 Rec'd PCT/PTO 11 AUG 1998

PHARMACEUTICAL COMPOSITIONS COMPRISING NATURAL HUMAN α-INTERFERON

The invention concerns pharmaceutical compositions for a peroral administration comprising natural human α-interferon isolated from lymphoblastoid or leukocitic cells. In particular compositions are useful for therapy of viral infections, in particular viral hepatitis, neoplasia and immunodeficiency syndromes. The interferon efficient dosages are clearly lower than dosages utilized for parenteral administration.

α-, β-, γ-interferons are usually administered by injection and are used for therapy. α-interferon is the most largely utilized interferon (1). In an updated study of medicaments for either acute or chronic viral hepatitis therapy (2), only α-interferon is widely accepted as single therapeutic agent.

"Viral hepatitis" means at least five different pathologies, having different agents, namely A, B, C, D, E.

The therapeutic trend is to treat said pathologies with α-interferon, with dosages according to the kind of hepatitis, to the overall status of the subject and to other variable factors. In general, further to the interferon treatment an almost normalisation clinical and biochemical parameters is achieved for chronic hepatitis (B, C, D). The interferon activity on acute hepatitis has not been focused yet, though for hepatitis C, a therapeutic treatment with α-interferon lowers the chronicition rate of the disease.

Therapeutic cycles indicate the day alternate administration through subcutaneous route of recombinant α-interferon (r α-IFN) at dosages of app. 5.000.000 UI, that in special cases can be up to 9.000.000 UI/day.

The length of therapeutic cycles is of from six months up to one year (nine months average).

In many cases, undesired side effects interfere with the course of therapeutic treatment. In fact some patients, in particular those at an advanced stage of disease or with severe physiologic damages, do not tolerate the therapy and therefore the treatment should be interrupted. Claimed side effects are: fever, nausea, vomit, tiredness, algia and depression.

Moreover the therapeutic cost are quite relevant both due to the high amount of active principle (more than 8.000 new cases each year in Italy and 300.000 world-wide) and to the necessity of hospitalisation just in consideration of said side effects further to the parenteral administration (day hospital or outpatients' department).

Finally, as far as chronic active viral hepatitis the only alternative to the interferon treatment is represented by liver transplant.

The clinical trend is to increase the posology dosage and the length of therapeutic cycle (3), but clinical data show (4): severe side effects; low acceptance by the patient; high therapeutic costs. Garcia et al. (5) report that the estimate for each cured patient is between 700.000 and 2.000.000 English pounds Capri S. (6) report that the cost of each interferon therapeutic treatment is of Lit. 70.000.000/subject.

It is therefore evident that the actual composition of interferon for therapeutic treatment of hepatitis is not optimal.

Moreover clinical results show a better therapeutic efficacy in patients which are not the main target for therapy, namely: young subjects, subjects with a disease at an initial stage, subjects infected with genotipic virus 2 or 3, low viremia subjects. On the contrary a less therapeutic efficacy can be found in those subjects which really need the therapeutic treatment (subjects poco respondent), as subjects affected by an aggressive

form (active chronic hepatitis), long length diseases affected subjects, over 50 subjects. Thus patients that really need an immediate interferon treatment are those that have a lower chance of success (7).

The authors of the instant invention have found a pharmaceutical composition comprising natural human α-interferon from either lymphoblastoid or leukocitic cells to be administered through peroral route, with dosages clearly lower than those used for parenteral administration. The composition maintains as unaltered chemical-physical, biological and pharmacological characteristics of the active principle, having a therapeutic effect substantially analogous to the compositions of prior art but overcoming disadvantages thereof.

The composition is preferably in a liquid form with a concentration of 100 to 500 UI/ml, preferably approx. 150 UI/ml, most preferably in mono-dosage units, most preferably of appr. 1 ml.

The composition acts by activating the defence mechanisms against viral infections, tumour growth and stimulates an immune response.

The utilisation of natural interferon was chosen for the better chances of therapeutic success with respects to recombinant interferon, obtained by cloning of a single subtype.

Though leukocitic and lymphoblastoid interferons exert the same therapeutic properties, the former can be advantageously produced. As a matter of fact it is obtainable by stabilised cell lines, without the need of blood donors.

Processes for purifying interferons are known to those skilled in the art, and for example are shown in US Patent 4,732,683; in Cantell K. and Hirvonen S. Texas Reports on Biology and Medicine, Vol. 35, p.138, 1977; in Zoon K.C. et al. Science 207, p. 527, 1980.

The peroral route is generally much more accepted by subjects, makes easier posology schemes and dosages, lowers to stops the antigenic risk, induces the transmission and amplification signal mechanism, with a mirato therapeutic effect, with dosages 100 times lower than known formulations for parenteral administrations.

The low dosage annuls the risk of toxic effects; allows a better availability of medicine to satisfy an increasing request and a drastic lowering of therapeutic costs.

The preferred formulation in dosage units of small volumes (1 ml) to drink allows an immediate availability of the active principle, a good standard of cleanliness from the monodosage primary container; the certainty of the taken dosage; the taking of the active principle to be immediately adsorbed by the oro-pharyngeal mucosa, easily preventing the deglutition, an ease and safe way of administration for all of patients, as opposite to lozenges or tablets formulations that should be kept in the mouth till to full dissolution, with high chances of swallowing.

Moreover the composition of the invention is conveniently used for home therapies or on the job place, as precautionary measure for the prophylaxis of viral pathologies, and to control chronic diseases which need of long therapeutic cycles (even yearly) and often recurrent.

The composition can be used also in association with other drugs to get synergism and optimize therapeutic schemes.

The following clinical studies show the therapeutic effect. A comparison of the electrophoretic protein pattern and of the concentration of IgG, IgA, IgM, before the beginning of the peroral therapy with natural human α-interferon of hepatitis or other pathologies affected subjects, before and after two weeks of therapeutic

treatment, allows to foreseen quali-quantitatively the subject response.

Subjects which respond to the therapy with 450UI/die dosages show a decrease of α2- and ß-globulins, of IgGs, of the IgG/IgA ratio, together to an increase of IgA and IgM concentrations, have a good chance of eliminate the HBVe antigen and to seroconvert, namely to confer a stable remission of the pathology.

On the other hand subjects which respond to the same therapy with a decrease of albumin serum concentration, of IgGs, IgAs, IgMs, together to an increase of α1-globulin fractions, should seronvert with longer times.

Moreover subjects that respond with an increase of IgGs, of the IgG/IgA ratio, together to a decrease of IgM and of the IgA/IgM ration, could be resistant to the therapy.

The monitoring of said parameters (markers) is useful for a planning of therapeutic strategies in clinic and also for the clinical practitioner.

Clinical studies on healthy subjects

Table 1 shows different therapeutic schemes.

Table 1

Exp.		active comp.	No. admin. /day	Dosages	days trt.	blood bleedings
A	aA	α-IF	1(3dsg)	450 UI	1	T_0, T_1, T_2, T_3,
	aB	placebo	1(3dsg)	-	1	T_0, T_1, T_2, T_3
B	bA	α-IF	1(3dsg)	450 UI	5	T_0, T_1, T_2, T_3, T_4, T_5, T_6, T_7
	bB	placebo	1(3dsg)	-	5	T_0, T_1, T_2, T_3, T_4, T_5, T_6, T_7
C	cA_1	α-IF	2(1dsg)	300 UI	1	T_0, T_1, T_2, T_3
	cA_2	α-IF	3(1dsg)	450 UI	1	T_0, T_1, T_2, T_3
	cb	placebo	3(1dsg)	-	1	T_0, T_1, T_2, T_3
D	dA_1	α-IF	2(1dsg)	300 UI	5	T_0, T_1, T_2, T_3, T_4, T_5, T_6, T_7
	dA_2	α-IF	3(1dsg)	450 UI	5	T_0, T_1, T_2, T_3, T_4, T_5, T_6, T_7
	dB	placebo	3(1dsg)	-	5	T_0, T_1, T_2, T_3, T_4, T_5, T_6, T_7

T_1 = background; T_2 = 1d further the first administration, T_3 = 2d further the first administration, T_4 = 3d further the first administration, T_5 = 4d further the first administration, T_6 = 5d further the first administration, T_7 = 1d after the treatment suspension, T_8 = 2d after the treatment suspension.

The change of the induced biological response with respect to the therapeutic scheme, has been measured on samples of blood, taken at different times. In particular the activity with respect to the day dosage of active principle, to the mono- or pluri-administration, to the length of the therapeutic cycle was measured.

The analysis of data show that natural human α-interferon from either lymphoblastoid or leukocitic cells, administered at low dosages for a peroral route, is able to modulate (according to the dosage and to the length of the therapeutic cycle) the expression of membrane antigen of healthy subject blood mononuclear cells. In particular, according to therapeutic scheme, the pharmaceutical composition seems to be able to increase both CD4 and CD8 cell population. It is also evident an increased expression of markers of cell activation, as DR antigens and interleukin 2 receptor.

The therapeutic scheme with 450 U/die x 5 d (exp.b) is the one provided better results, as shown in Tables 2 and 3. In fact there is an increase (% and absolute) of CD3, CD4, DR1, CD25 lymphocytes. Said increases are, according to different cases, better evident at T_3, T_4, T_5 times to later decrease at T_6 and T_7 times.

The same posology dosage, but with a shorter therapeutic cycle (1 day) (exp.a), interferes less evidently with the % and absolute numbers of mononuclear cells in the blood (Tables 4 e 5). In fact in this experiment an increase of average percentage values but not of absolute T, CD8, and class II hystocompatibility antigen lymphocytes values, is evident at time T_3.

Other experimental conditions show lower increases of the immune response.

Therefore, natural human α-interferon from either lymphoblastoid or leukocitic cells, administered at low dosages trough peroral route, shows an important role in modulating the immune response, both in the phase afferent than efferent, e has a therapeutic application for the treatment of infective diseases and of other conditions of immunodeficiency.

Clinical studies on hepatitis subjects

Viral B Hepatitis

14 patients affected by chronic viral B hepatitis, with an age comprised between 4 and 59, were used for random studies.

All of subject were previously treated for different periods ranging from some months to some years with steroids, or with steroid-azothiopurine, with no beneficial effects, neither for the clinical symptomatology nor for the biochemical parameters of the disease, which evolved, in some cases, to hepatic cirrhosis.

The therapeutic treatment of a one administration of 150U/day was initiated immediately after the suspension of the previous treatment, and effects of said treatment were monitored by checking any alteration of the immune response; of the haematological and biochemical parameters; of serum markers of the viral infection and of the hystochemistry of hepatic bioptic samples.

The time of observation varied from 15 to 32 months and results can be summarized in the following:

1) all of patients during the first 3-6 weeks of treatment registered a transient decay of hepatic biochemical functions (i.e. a 2-3 fold increase of alanineaminetransferase (ALT) levels), with no clinical symptoms of disease worsening;

2) the phenomenon goes on for 4-6 weeks;

3) in all of treated patients an intense activation of the immune system was observed, even after the therapeutic treatment;

4) 7 patients eliminate HBV DNA and HBeAg from serum and stable seroconvert;

5) 1 patient has an HBcAg increased title, more than the original value;

6) in other 9 patients said titre decreases significatively.

Therefore, 50% of patients get a stable remission of the disease.

Viral C Hepatitis

The therapeutic standard of viral hepatitis C foresees the use of α-interferon through parenteral route.

6 active chronic hepatitis C affected patients were subjected to therapy with peroral administration at 150U/die, by starting the treatment just after the suspension of the steroid therapy.

The observation time (equal to the length of the treatment) resulted to be variable from 19 to 69 weeks. In general the treatment was well tolerated and all of patients registered a significant increase of vivacity and appetite, with a better tolerance to physical exercises.

No patients got a normalization of transaminase levels during the observation period, but one which registered the biochemical and clinical remission of the disease, after the treatment suspension at the 19th week due to an increasing of articular pains.

Results are shown in tables 2-5.

BIBLIOGRAPHY

1) Howard M. et al. Le Scienze n.311 Vol LIII 72-80 (1994).

2) Saracco G., Rizzetto M. Biomed. Pharmacother. 49 (2),55-57 (1995).

3) Kasahara A.K., et al., Hepatology; 21, 291-297 (1995).

4) Paoletti A. et al.; Clin. Ter. 146(5), 343-349 (1995).

5) Garcia De Ancos J.L. et al.; J. Hepatol. 11:s11-s18 (1990).

6) Capri S. Adis International, Milano, pp 41-49 (1994).

7) Bianchi F.B., La rivista del medico pratico, Ott. (suppl.5) (1995).

TREATMENT	TIME	%CD3	%CD4	%CD8	%CD25	%MHCII	%B	%NK	%CD14
450UI/d x 5d 3ds	T_0	69,2±4,9	42,8±4,3	26,3±2,9	1,4±0,9	7,5±0,8	11,5±1,1	6,9±0,7	10,3±1,6
PLACEBO x 5d 3ds	T_0	71,3±5,2	41,7±4,1	24,5±3,5	<0,5	8,1±1,2	13,1±1,6	8,1±1,3	9,3±1,2
450UI/d x 5d 3ds	T_1	70,1±5,1	43,1±4,5	25,8±3,1	<0,5	8,2±1,3	12,1±1,4	7,2±1,3	3,9±1,4
PLACEBO x 5d 3ds	T_1	72,4±5,4	40,8±3,9	25,3±3,8	<0,5	8,7±1,4	12,7±1,8	8,2±1,5	10,1±1,3
450UI/d x 5d 3ds	T_2	70,2±5,1	44,2±3,1	23,2±3,1	1,7±1,3	9,1±1,3	12,5±1,6	7,1±0,9	11,1±1,5
PLACEBO x 5d 3ds	T_2	70,8±5,3	41,1±4,2	24,7±3,7	1,2±0,9	8,7±1,4	11,4±1,6	6,9±1,9	10,8±1,7
450UI/d x 5d 3ds	T_3	69,8±5,7	49,4±4,9	24,1±3,6	2,5±1,6	14,2±1,3	12,1±1,4	7,2±1,1	9,7±1,8
PLACEBO x 5d 3ds	T_3	71,3±5,6	41,5±4,3	24,4±3,5	<0,5	8,5±1,3	13,1±1,8	6,9±1,7	10,1±1,8
450UI/d x 5d 3ds	T_4	72,3±5,8	49,7±5,1	23,8±3,8	2,3±1,7	14,2±2,5	12,5±1,8	6,8±0,9	9,4±1,5
PLACEBO x 5d 3ds	T_4	69,8±5,3	40,9±4,2	25,2±4,3	<0,5	7,9±0,9	12,9±1,9	7,1±0,7	11,6±2,1
450UI/d x 5d 3ds	T_5	71,8±5,4	53,3±4,9	74,2±4,1	2,5±1,6	14,2±1,9	13,5±2,1	7,3±0,9	11,3±1,6
PLACEBO x 5d 3ds	T_5	70,6±5,5	41,3±4,1	25,9±4,4	1,4±1,3	8,1±1,3	12,6±1,4	7,5±0,9	9,9±2,3
450UI/d x 5d 3ds	T_6	69,7±5,2	50,7±4,7	23,7±4,1	1,6±0,9	11,3±1,5	12,8±1,9	6,9±0,6	10,8±1,9
PLACEBO x 5d 3ds	T_6	71,3±5,6	42,3±4,3	24,7±3,8	<0,5	7,9±1,4	11,4±1,1	7,3±0,5	10,4±1,9
450UI/d x 5d 3ds	T_7	70,2±5,1	45,3±4,4	24,2±3,8	1,1±0,9	8,7±1,1	12,3±1,6	7,1±0,7	11,2±7,1
PLACEBO x 5d 3ds	T_7	71,5±5,8	41,5±3,9	25,1±4,1	<0,5	8,1±1,6	11,9±1,4	7,8±0,8	9,8±1,7

b vs a = p<0,05 ; c vs a = p<0,01 ; e vs d = p<0,01 ; f vs d = p<0,05 Student's "t" test

Tab. 2 -

TREATMENT	TIME	CD3 n°/mm³	CD4 n°/mm³	CD8 n°/mm³	CD25 n°/mm³	MHCII n°/mm³	B n°/mm³	NK n°/mm³	CD14 n°/mm³
450UI/d x 5d 3ds	T_0	1776±323	1074±208	560±145	35±23	188±60	288±87	173±88	177±78
PLACEBO x 5d 3ds	T_0	1658±220	970±195	565±171	<13	188±68	305±77	188±90	203±88
450UI/d x 5d 3ds	T_1	1858±128	1142±213	684±95	<13	217±53	320±65	191±73	213±95
PLACEBO x 5d 3ds	T_1	1784±195	1005±191	623±182	<13	214±73	313±142	302±85	216±90
450UI/d x 5d 3ds	T_2	1986±130	1251±115	657±98	48±33	258±43	354±70	301±73	196±138
PLACEBO x 5d 3ds	T_2	1746±183	1034±197	594±182	30±20	215±103	281±87	170±84	205±140
450UI/d x 5d 3ds	T_3	1878±132	1339±223	648±190	67±40	382±65	326±65	194±78	243±75
PLACEBO x 5d 3ds	T_3	1555±190	905±230	530±81	<11	185±130	286±52	150±99	234±72
450UI/die x 5d 3ds	T_4	1994±178	1325±168	539±195	62±43	381±90	336±145	183±75	187±48
PLACEBO x 5d 3ds	T_4	1733±213	1138±197	701±200	<14	230±121	359±174	198±76	167±69
450UI/d x 5d 3ds	T_5	2001±175	1456±283	579±203	70±40	399±108	379±88	205±73	197±140
PLACEBO x 5d 3ds	T_5	1720±226	1007±195	531±132	34±31	197±115	307±153	183±71	196±131
450UI/d x 5d 3ds	T_6	1719±170	1238±175	585±170	39±23	379±138	316±84	170±75	213±68
PLACEBO x 5d 3ds	T_6	1578±230	736±300	547±138	<11	175±132	252±126	162±62	242±74
450UI/d x 5d 3ds	T_7	1704±128	1058±170	586±105	27±23	211±128	298±97	172±78	197±83
PLACEBO x 5d 3ds	T_7	1595±235	924±191	559±195	<11	180±51	265±133	174±65	228±90

b vs s = $p<0,05$; d vs c = $p<0,05$; f vs c = $p<0,01$ Student's "t" test

Tab. 3 =

TREATMENT	TIME	%CD3	%CD4	%CD8	%CD25	%MHCII	%B	%NK	%CD14
450UI/d x 1d 3ds	T_0	70,3±5,7	42,4±3,8	25,3±2,6	1,7±1,4	7,2±0,8	9,7±1,4	8,4±0,9	8,4±0,7
PLACEBO x 1d 3ds	T_0	69,9±5,3	43,8±4,2	24,3±2,7	<0,5	7,9±0,9	10,9±1,7	7,8±0,8	9,8±0,9
450UI/d x 1d 3ds	T_1	69,4±5,5	43,9±4,5	24,8±1,9	<0,5	8,3±1,3	10,5±1,7	9,3±2,1	8,3±0,8
PLACEBO x 1d 3ds	T_1	70,2±5,9	43,5±4,4	23,8±2,5	<0,5	8,2±1,3	11,2±1,8	7,3±1,2	8,5±0,6
450UI/d x 1d 3ds	T_2	73,6±6,1	43,5±4,3	27,3±3,1	<0,5	8,1±1,2	11,2±2,1	10,7±4,5	9,3±1,5
PLACEBO x 1d 3ds	T_2	70,1±5,6	44,1±4,7	24,7±3,3	1,4±0,9	7,7±1,4	12,1±2,7	8,1±0,9	8,8±1,3
450UI/d x 1d 3ds	T_3	77,8±6,2	44,1±4,8	2,7±2,4	2,3±1,9	11,2±1,5	10,9±1,9	8,3±0,7	12,2±3,1
PLACEBO x 1d 3ds	T_3	70,3±5,4	43,9±5,1	24,7±3,3	<0,5	8,1±0,9	10,5±1,7	8,5±1,6	10,7±1,4

b vs a = $p<0,01$; c vs d = $p<0,05$; e vs f = $p<0,05$ Student's "t" test

Tab. 4 -

TREATMENT	TIME	CD3 n°/mm³	CD4 n°/mm³	CD8 n°/mm³	CD25 n°/mm³	MHCII n°/mm³	B n°/mm³	NK n°/mm³	CD14 n°/mm³
450UI/d x 1d 3ds	T_0	1521±223	917±182	547±156	37±30	156±77	210±80	182±80	182±75
PLACEBO x 1d 3ds	T_0	1615±222	1012±197	561±162	<12	183±81	252±99	180±66	210±81
450UI/d x 1d 3ds	T_1	1501±218	949±189	536±141	<11	180±128	227±97	201±57	192±79
PLACEBO x 1d 3ds	T_1	1637±236	1014±202	555±188	<12	191±80	261±72	170±89	177±63
450UI/d x 1d 3ds	T_2	1587±132	936±183	589±97	<11	175±126	242±85	230±98	215±72
PLACEBO x 1d 3ds	T_2	1723±329	1083±189	607±172	34±21	189±82	297±62	199±71	206±80
450UI/d x 1d 3ds	T_3	1654±234	940±184	631±101	49±41	238±124	231±91	176±76	234±67
PLACEBO x 1d 3ds	T_3	1673±124	1045±178	588±76	<12	193±91	250±49	202±94	251±82

b vs a = $p<0,05$; d vs c = $p<0,05$; f vs e = $p<0,01$ Student's "t" test

Tab. 5 -